

**Region 10
U.S. Environmental Protection
Agency**

DRAFT FINAL

**Phase I Sediment Sampling
Data Evaluation
Upper Columbia River Site
CERCLA RI/FS
Section 4 pages 76 - 83**

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SECTION 4

Sediment Constituents of Interest

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Sediment Constituents of Interest

This section describes the process employed to identify the COIs evaluated in this document. These COIs comprise a subset of the target analytes that were sampled and analyzed for during the Phase I RI/FS sediment sampling program and that are considered in the nature and extent and fate and transport of contaminants evaluations for UCR sediments as presented in this document. Identification of a constituent as a COI does not necessarily signify that the constituent poses unacceptable risk to human or ecological receptors. A list of site-specific risk-based sediment COCs for UCR sediments will be developed as part of the human health risk assessment being conducted by USEPA and an ecological risk assessment that will be conducted by Teck Cominco American, Inc . The COCs and results of those risk assessments will be presented in separate documents.

4.1 Identification Process

The process for identifying COIs for UCR sediment began with development of a comprehensive target analyte list (TAL) for the Phase I sediment investigation. The TAL presented in the QAPP (CH2M HILL, 2005) was based on historical information about upstream facilities, industry-related chemical literature, and information about releases, as well as results from previous investigations and the preliminary conceptual site model for sediment. The TAL included metals (plus uranium), SVOCs, pesticides, and PCBs; dioxins and furans were also analyzed for in samples collected from beaches and sediment cores. A full listing of TAL constituents was presented in Table 2-1 of the QAPP.

The COIs are a subset of the TAL chemicals. The process for identifying TAL constituents as COIs consisted of grouping analytical data of similar sample types and comparing the analytical results for each group to the selected screening levels. Any constituent that was detected above one or more selected screening level was identified as a COI for evaluation and presentation in this document. The following subsections provide more information about the sources of data and screening levels used in the COI identification process.

4.1.1 Data Sources

Only Phase I sediment analytical data were used for identification of COIs because that data set provides full areal coverage of the site and includes a complete target analyte list with detection limits that are sufficiently low to compare to the screening levels being used. Samples collected during previous investigations were not included in the evaluation because of incomplete coverage, missing target analytes, and/or inadequate detection limits.

Four separate evaluation groups were established for the COI identification process:

- **River Group.** Transect, bioassay, and tributary samples obtained along the UCR.

- **Beach Group.** Composite, discrete, and size-fractionated samples obtained at UCR beaches. This group was separated from the River Group to allow identification of COIs that are specific to locations where recreational use may be concentrated.
- **Core Group.** Samples obtained at surface and subsurface intervals from cores taken at mid-channel locations in the middle and lower reaches of the UCR. This group was separated from the River Group to allow identification of COIs that may be related to historical transportation and deposition of contaminated sediments.
- **Reference Group.** Samples collected from near-UCR tributary sediment at elevations that are expected to be unaffected by UCR contaminants. This group was not considered in development of the COI list. Its use was limited to assessment of the sediment bioassay test results, which are reported in a separate document (CH2M HILL, 2006b).

The assigned COI evaluation group for each sample is listed in Appendix C, Table C-5.

4.1.2 Screening Levels

The screening levels used in identifying COIs are a subset of the potential regulatory values for UCR sediment presented in Table A-4 of the QAPP. The sources of these values are listed in Section 3.3. For human exposure, the USEPA Region 9 PRGs, CCT sediment cleanup levels, and STI sediment cleanup levels were used; for ecological exposure, the PECs and TECs developed as part of consensus-based sediment quality guidelines (MacDonald et al., 2000) were used.

All of these screening criteria were used for the COI identification process irrespective of the sample type (e.g., beach, bank, mid-channel, core). Comparison of each of the sediment sample types to each of these screening criteria is considered conservative because the likely exposure scenarios that each of the screening criteria was developed for do not necessarily apply to the environmental settings from which the sample types were collected. For example, human contact with UCR sediment is more likely to occur in bank areas and beaches than in the mid-channel portions of the river; nonetheless, all sediment samples, including mid-channel and core sediment samples, were compared to all the selected screening criteria values, including those developed to screen for human contact. This conservative COI selection approach accounts for potential future remobilization of the contaminants.

4.2 COI Identification Results

The analytical data and results of comparisons to the screening values are summarized by sample group and analyte in Table 4-1. The table provides statistical descriptions of the constituents, including frequency of detection, range of detected concentrations, range of reporting limits (for nondetects), and the number of screening level exceedances for all constituents that were detected above screening levels in one or more sample groups.

A full listing of summary statistics for all chemicals, including those that were not detected, is provided in Appendix C, Tables C-1 through C-4.

COIs were identified for each group and consist of constituents for which one or more sample results exceeded at least one screening level. The COI list for each sample group was then consolidated into a single list of COIs for sediment, as follows:

- Metals: antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, uranium, and zinc
- Organics
 - Pesticides: 2,4-DDE, 2,4-DDT, 4,4-DDD, 4,4-DDE, 4,4-DDT, and aldrin
 - PCBs: Aroclor 1016 and Aroclor 1260
 - Dioxins and furans: including 2,3,7,8 TCDD toxicity equivalent (TEQ) and 14 congeners, as listed in Table 4-1
 - PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene

The distributions and fate and transport characteristics of these compounds are discussed in Section 5 of this report.

4.3 Reference Area Results

Samples were collected at six upstream locations that are expected to be unaffected by UCR contaminants. Reference sample locations are illustrated in Figures 2-3 through 2-6. The summarized results and comparisons to human and ecological screening levels are presented at the bottom of Table 4-1. As indicated in the table, arsenic, cadmium, nickel, benzo(a)anthracene, and chrysene were detected in the reference samples at concentrations above screening levels, although the concentrations are much lower in the reference area samples than the UCR samples in which these are detected. However, it is emphasized that the purpose of the reference area samples was to support the interpretation of the sediment bioassay test results. The reference area samples were not intended to define background concentrations of COIs in sediment.

TABLE 4-1

Summary of Analytical Results and Comparison to Screening Levels

Upper Columbia River RI/FS

Size Fraction	Analyte	Units	Summary Statistics								Comparisons to Screening Levels									
			Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetect Value	Maximum Nondetect Value	Minimum Detected Value	Maximum Detected Value	PRG Soil Residential ^a	Number of Detects > PRG	STI HSCA HH ^b	Number of Detects > STI HSCA HH	TEC ^c	Number of Detects > TEC	PEC ^d	Number of Detects > PEC	CCT HH Value ^e	Number of Carbon-Normalized Detects > CCT HH Value	
Beach Group (Discrete, composite, and size fractionated samples collected from beaches)																				
Whole	Antimony	mg/Kg	35	57	61%	0.29	8.1	0.53	53	31	7	16	9	--	--	--	--	NA	--	
Whole	Arsenic	mg/Kg	64	66	97%	0.97	3.9	0.97	36	0.39	64	0.12	64	9.8	14	33	1	NA	--	
Whole	Cadmium	mg/Kg	57	66	86%	0.058	0.52	0.056	7.8	37	--	20	--	0.99	26	5.0	3	NA	--	
Whole	Chromium	mg/Kg	66	66	100%	--	--	5.6	145	211 ^f	--	200	--	43	10	111	4	NA	--	
Whole	Copper	mg/Kg	66	66	100%	--	--	4.2	3,290	3,129	1	1,490	6	32	21	149	16	NA	--	
Whole	Iron	mg/Kg	66	66	100%	--	--	4,930	254,000	23,463	18	--	--	--	--	--	--	NA	--	
Whole	Lead	mg/Kg	66	66	100%	--	--	3.1	535	400	1	--	--	36	27	128	22	NA	--	
Whole	Manganese	mg/Kg	66	66	100%	--	--	95	4,780	1,762	9	1,870	9	--	--	--	--	NA	--	
Whole	Mercury	mg/Kg	45	66	68%	0.098	0.11	0.0040	0.81	23	--	12	--	0.18	9	1.1	--	NA	--	
Whole	Nickel	mg/Kg	66	66	100%	--	--	4.1	30	1,564	--	800	--	23	2	49	--	NA	--	
Whole	Uranium	mg/Kg	19	66	29%	9.8	30	4.6	84	16	3	8.0	9	--	--	--	--	NA	--	
Whole	Zinc	mg/Kg	66	66	100%	--	--	21	22,200	23,463	--	12,000	6	121	35	459	21	NA	--	
< 75 um	Arsenic-Sieved <75 um	mg/Kg	3	3	100%	--	--	2.0	10	0.39	3	0.12	3	9.8	1	33	--	NA	--	
< 75 um	Cadmium-Sieved <75 um	mg/Kg	3	3	100%	--	--	0.82	5.5	37	--	20	--	0.99	2	5.0	1	NA	--	
< 75 um	Copper-Sieved <75 um	mg/Kg	3	3	100%	--	--	24	278	3,129	--	1,490	--	32	1	149	1	NA	--	
< 75 um	Iron-Sieved <75 um	mg/Kg	3	3	100%	--	--	21,000	35,100	23,463	2	--	--	--	--	--	--	NA	--	
< 75 um	Lead-Sieved <75 um	mg/Kg	3	3	100%	--	--	22	325	400	--	--	--	36	2	128	1	NA	--	
< 75 um	Mercury-Sieved <75 um	mg/Kg	3	3	100%	--	--	0.031	0.32	23	--	12	--	0.18	1	1.1	--	NA	--	
< 75 um	Nickel-Sieved <75 um	mg/Kg	3	3	100%	--	--	19	27	1,564	--	800	--	23	1	49	--	NA	--	
< 75 um	Zinc-Sieved <75 um	mg/Kg	3	3	100%	--	--	106	1,860	23,463	--	12,000	--	121	2	459	1	NA	--	
> 75 um	Antimony-Sieved >75 um	mg/Kg	1	1	100%	--	--	47	47	31	1	16	1	--	--	--	--	NA	--	
> 75 um	Arsenic-Sieved >75 um	mg/Kg	3	3	100%	--	--	1.2	10	0.39	3	0.12	3	9.8	1	33	--	NA	--	
> 75 um	Cadmium-Sieved >75 um	mg/Kg	3	3	100%	--	--	0.34	4.8	37	--	20	--	0.99	1	5.0	--	NA	--	
> 75 um	Chromium-Sieved >75 um	mg/Kg	3	3	100%	--	--	13	80	211 ^f	--	200	--	43	1	111	--	NA	--	
> 75 um	Copper-Sieved >75 um	mg/Kg	3	3	100%	--	--	9.8	1,530	3,129	--	1,490	1	32	1	149	1	NA	--	
> 75 um	Iron-Sieved >75 um	mg/Kg	3	3	100%	--	--	12,800	126,000	23,463	1	--	--	--	--	--	--	NA	--	
> 75 um	Lead-Sieved >75 um	mg/Kg	3	3	100%	--	--	7.5	267	400	--	--	--	36	1	128	1	NA	--	
> 75 um	Manganese-Sieved >75 um	mg/Kg	3	3	100%	--	--	187	2,380	1,762	1	1,870	1	--	--	--	--	NA	--	
> 75 um	Zinc-Sieved >75 um	mg/Kg	3	3	100%	--	--	45	10,100	23,463	--	12,000	--	121	2	459	1	NA	--	
Whole	Benzo(a)anthracene	µg/Kg	20	66	30%	4.0	8.0	0.30	12	621	--	240	--	108	--	1,050	--	21.6	20	
Whole	Benzo(a)pyrene	µg/Kg	17	66	26%	4.0	8.0	0.40	13	62	--	24	--	150	--	1,450	--	21.6	17	
Whole	Benzo(b)fluoranthene	µg/Kg	16	66	24%	4.0	8.0	0.30	9.0	621	--	240	--	--	--	--	--	21.6	16	
Whole	Benzo(k)fluoranthene	µg/Kg	9	66	14%	4.0	13	0.30	7.0	6,215	--	2,400	--	--	--	--	--	21.6	9	
Whole	Chrysene	µg/Kg	37	66	56%	4.0	8.0	0.20	17	62,146	--	24,000	--	166	--	1,290	--	13.79	37	
Whole	Dibenz(a,h)anthracene	µg/Kg	12	66	18%	3.7	8.0	0.40	3.0	62	--	24	--	33	--	--	--	21.6	12	
Whole	Indeno[1,2,3-cd]pyrene	µg/Kg	17	66	26%	4.0	8.0	0.20	11	621	--	240	--	--	--	--	--	21.6	17	
< 75 um	Benzo(a)anthracene-Sieved <75 um	µg/Kg	2	2	100%	--	--	0.30	3.0	621	--	240	--	108	--	1,050	--	21.6	2	
< 75 um	Chrysene-Sieved <75 um	µg/Kg	2	2	100%	--	--	1.0	6.0	62,146	--	24,000	--	166	--	1,290	--	13.79	2	
> 75 um	Benzo(a)anthracene-Sieved >75 um	µg/Kg	1	3	33%	4.0	4.0	1.0	1.0	621	--	240	--	108	--	1,050	--	21.6	1	
> 75 um	Benzo(a)pyrene-Sieved >75 um	µg/Kg	1	3	33%	4.0	4.0	2.0	2.0	62	--	24	--	150	--	1,450	--	21.6	1	
> 75 um	Benzo(b)fluoranthene-Sieved >75 um	µg/Kg	1	3	33%	4.0	4.0	2.0	2.0	621	--	240	--	--	--	--	--	21.6	1	
> 75 um	Benzo(k)fluoranthene-Sieved >75 um	µg/Kg	1	3	33%	4.0	4.0	2.0	2.0	6,215	--	2,400	--	--	--	--	--	21.6	1	
> 75 um	Chrysene-Sieved >75 um	µg/Kg	3	3	100%	--	--	0.20	2.0	62,146	--	24,000	--	166	--	1,290	--	13.79	3	
Whole	2,4'-DDE	µg/Kg	4	66	6%	0.68	1.3	0.32	17											

TABLE 4-1

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			Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetect Value	Maximum Nondetect Value	Minimum Detected Value	Maximum Detected Value	PRG Soil Residential ^a	Number of Detects > PRG	STI HSCA HH ^b	Number of Detects > STI HSCA HH	TEC ^c	Number of Detects > TEC	PEC ^d	Number of Detects > PEC	CCT HH Value ^e	Number of Carbon-Normalized Detects > CCT HH Value
> 75 um	2,4'-DDT-Sieved >75 um	µg/Kg	2	3	67%	0.68	0.68	0.19	0.54	1,720	--	--	--	4.2	--	63	--	2.04	2
> 75 um	4,4'-DDT-Sieved >75 um	µg/Kg	2	3	67%	0.68	0.68	0.98	1.9	1,720	--	515	--	4.2	--	63	--	2.04	2
Whole	1,2,3,4,6,7,8-Heptachlorodibenzodioxin	PG/G	25	49	51%	0.10	2.0	0.95	11	--	--	--	--	--	--	--	--	3,760	1
Whole	1,2,3,4,6,7,8-Heptachlorodibenzofuran	PG/G	26	49	53%	0.047	0.42	0.076	11	--	--	--	--	--	--	--	--	3,760	1
Whole	1,2,3,4,7,8-Hexachlorodibenzodioxin	PG/G	20	49	41%	0.034	0.16	0.026	0.23	--	--	--	--	--	--	--	--	14.4	9
Whole	1,2,3,4,7,8-Hexachlorodibenzofuran	PG/G	6	49	12%	0.018	0.28	0.022	0.24	--	--	--	--	--	--	--	--	14.4	3
Whole	1,2,3,6,7,8-Hexachlorodibenzodioxin	PG/G	24	49	49%	0.035	0.67	0.051	0.84	--	--	--	--	--	--	--	--	14.4	17
Whole	1,2,3,6,7,8-Hexachlorodibenzofuran	PG/G	10	49	20%	0.027	0.20	0.019	0.19	--	--	--	--	--	--	--	--	14.4	6
Whole	1,2,3,7,8,9-Hexachlorodibenzodioxin	PG/G	20	49	41%	0.034	0.51	0.036	0.60	--	--	28	--	--	--	--	--	14.4	17
Whole	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	PG/G	13	49	27%	0.024	0.17	0.022	0.26	--	--	--	--	--	--	--	--	8.2	7
Whole	1,2,3,7,8-Pentachlorodibenzofuran	PG/G	10	49	20%	0.019	0.27	0.026	0.33	--	--	--	--	--	--	--	--	8.2	11
Whole	2,3,4,6,7,8-Hexachlorodibenzofuran	PG/G	7	49	14%	0.018	0.24	0.016	0.079	--	--	--	--	--	--	--	--	14.4	4
Whole	2,3,4,7,8-Pentachlorodibenzofuran	PG/G	16	49	33%	0.024	0.19	0.028	0.61	--	--	--	--	--	--	--	--	8.2	13
Whole	2,3,7,8-Tetrachlorodibenzodioxin	PG/G	7	49	14%	0.032	0.11	0.094	0.28	--	--	1.2	--	--	--	--	--	0.047	7
Whole	2,3,7,8-Tetrachlorodibenzofuran	PG/G	33	49	67%	0.057	0.20	0.072	24	--	--	--	--	--	--	--	--	4.1	26
Whole	Octachlorodibenzodioxin	PG/G	30	49	61%	1.3	7.9	4.0	87	--	--	--	--	--	--	--	--	37,600	1
< 75 um	1,2,3,4,7,8-Hexachlorodibenzodioxin	PG/G	2	2	100%	--	--	0.19	0.29	--	--	--	--	--	--	--	--	14.4	2
< 75 um	1,2,3,4,7,8-Hexachlorodibenzofuran	PG/G	1	2	50%	0.083	0.083	0.30	0.30	--	--	--	--	--	--	--	--	14.4	1
< 75 um	1,2,3,6,7,8-Hexachlorodibenzodioxin	PG/G	2	2	100%	--	--	0.34	0.72	--	--	--	--	--	--	--	--	14.4	2
< 75 um	1,2,3,6,7,8-Hexachlorodibenzofuran	PG/G	1	2	50%	0.095	0.095	0.29	0.29	--	--	--	--	--	--	--	--	14.4	1
< 75 um	1,2,3,7,8,9-Hexachlorodibenzodioxin	PG/G	2	2	100%	--	--	0.30	0.50	--	--	28	--	--	--	--	--	14.4	2
< 75 um	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	PG/G	1	2	50%	0.13	0.13	0.30	0.30	--	--	--	--	--	--	--	--	8.2	1
< 75 um	1,2,3,7,8-Pentachlorodibenzofuran	PG/G	1	2	50%	0.14	0.14	0.20	0.20	--	--	--	--	--	--	--	--	8.2	1
< 75 um	2,3,4,6,7,8-Hexachlorodibenzofuran	PG/G	1	2	50%	0.13	0.13	0.27	0.27	--	--	--	--	--	--	--	--	14.4	1
< 75 um	2,3,4,7,8-Pentachlorodibenzofuran	PG/G	1	2	50%	0.24	0.24	0.29	0.29	--	--	--	--	--	--	--	--	8.2	1
< 75 um	2,3,7,8-Tetrachlorodibenzofuran	PG/G	2	2	100%	--	--	1.6	4.0	--	--	--	--	--	--	--	--	4.1	2
> 75 um	1,2,3,6,7,8-Hexachlorodibenzodioxin	PG/G	2	4	50%	0.084	0.17	0.15	0.17	--	--	--	--	--	--	--	--	14.4	2
> 75 um	1,2,3,7,8,9-Hexachlorodibenzodioxin	PG/G	1	4	25%	0.085	0.16	0.13	0.13	--	--	28	--	--	--	--	--	14.4	1
> 75 um	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	PG/G	1	4	25%	0.11	0.15	0.073	0.073	--	--	--	--	--	--	--	--	8.2	1
> 75 um	2,3,4,6,7,8-Hexachlorodibenzofuran	PG/G	2	4	50%	0.060	0.086	0.059	0.081	--	--	--	--	--	--	--	--	14.4	1
> 75 um	2,3,7,8-Tetrachlorodibenzofuran	PG/G	4	4	100%	--	--	0.12	1.2	--	--	--	--	--	--	--	--	4.1	3
Core Samples																			
Whole	Antimony	mg/Kg	13	28	46%	0.82	15	0.71	43	31	3	16	5	--	--	--	--	NA	--
Whole	Arsenic	mg/Kg	40	44	91%	1.2	1.9	0.95	18	0.39	40	0.12	40	9.8	11	33	--	NA	--
Whole	Cadmium	mg/Kg	39	44	89%	0.48	0.52	0.050	18	37	--	20	--	0.99	23	5.0	13	NA	--
Whole	Chromium	mg/Kg	44	44	100%	--	--	9.0	109	211 ^f	--	200	--	43	6	111	--	NA	--
Whole	Copper	mg/Kg	44	44	100%	--	--	9.2	2,240	3,129	--	1,490	4	32	28	149	12	NA	--
Whole	Iron	mg/Kg	44	44	100%	--	--	12,500	266,000	23,463	25	--	--	--	--	--	NA	--	
Whole	Lead	mg/Kg	44	44	100%	--	--	4.4	1,230	400	16	--	--	36	29	128	28	NA	--
Whole	Manganese	mg/Kg	44	44	100%	--	--	189	4,690	1,762	11	1,870	11	--	--	--	NA	--	
Whole	Mercury	mg/Kg	37	44	84%	0.0040	0.014	0.0050	3.2	23	--	12	--	0.18	17	1.1	8	NA	--
Whole	Nickel	mg/Kg	44	44	100%	--	--	6.6	33	1,564	--	800	--	23	15	49	--	NA	--
Whole	Uranium	mg/Kg	6	44	14%	17	53	20	90	16	6	8.0	6	--	--	--	NA	--	
Whole</																			

TABLE 4-1

Summary of Analytical Results and Comparison to Screening Levels

Upper Columbia River RI/FS

Size Fraction	Analyte	Units	Summary Statistics							Comparisons to Screening Levels									
			Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetect Value	Maximum Nondetect Value	Minimum Detected Value	Maximum Detected Value	PRG Soil Residential ^a	Number of Detects > PRG	STI HSCA HH ^b	Number of Detects > STI HSCA HH	TEC ^c	Number of Detects > TEC	PEC ^d	Number of Detects > PEC	CCT HH Value ^e	Number of Carbon-Normalized Detects > CCT HH Value
Whole	4,4'-DDE	µg/Kg	4	44	9%	0.70	1.9	0.16	0.81	1,720	--	515	--	3.2	--	31	--	1.72	4
Whole	4,4'-DDT	µg/Kg	2	44	5%	0.69	1.9	1.0	2.6	1,720	--	515	--	4.2	--	63	--	2.04	2
Whole	1,2,3,4,6,7,8-Heptachlorodibenzodioxin	PG/G	17	23	74%	0.16	0.29	0.27	45	--	--	--	--	--	--	--	--	3.76	1
Whole	1,2,3,4,7,8-Hexachlorodibenzodioxin	PG/G	11	23	48%	0.055	0.16	0.050	0.66	--	--	--	--	--	--	--	--	0.0144	8
Whole	1,2,3,4,7,8-Hexachlorodibenzofuran	PG/G	10	23	43%	0.020	0.24	0.12	0.94	--	--	--	--	--	--	--	--	0.0144	9
Whole	1,2,3,6,7,8-Hexachlorodibenzodioxin	PG/G	13	23	57%	0.051	0.10	0.12	2.6	--	--	--	--	--	--	--	--	0.0144	13
Whole	1,2,3,6,7,8-Hexachlorodibenzofuran	PG/G	6	23	26%	0.020	0.63	0.074	0.66	--	--	--	--	--	--	--	--	0.0144	4
Whole	1,2,3,7,8,9-Hexachlorodibenzodioxin	PG/G	13	23	57%	0.051	0.10	0.091	1.9	--	--	28	--	--	--	--	--	0.0144	13
Whole	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	PG/G	11	23	48%	0.032	0.12	0.060	0.67	--	--	--	--	--	--	--	--	0.0082	10
Whole	1,2,3,7,8-Pentachlorodibenzofuran	PG/G	6	23	26%	0.020	0.29	0.37	0.72	--	--	--	--	--	--	--	--	0.0082	6
Whole	2,3,4,6,7,8-Hexachlorodibenzofuran	PG/G	15	23	65%	0.022	0.16	0.021	0.94	--	--	--	--	--	--	--	--	0.0144	11
Whole	2,3,4,7,8-Pentachlorodibenzofuran	PG/G	10	23	43%	0.023	0.27	0.18	1.5	--	--	--	--	--	--	--	--	0.0082	10
Whole	2,3,7,8-Tetrachlorodibenzodioxin	PG/G	11	23	48%	0.023	0.064	0.11	0.59	--	--	1.2	--	--	--	--	--	4.70E-05	11
Whole	2,3,7,8-Tetrachlorodibenzofuran	PG/G	21	23	91%	0.089	0.10	0.076	53	--	--	--	--	--	--	--	--	0.0041	21
Whole	TEQ WHO-98	PG/G	23	23	100%	--	--	0.013	7.6	3.9	5	--	--	--	--	--	--	NA	--
River Group (transect, bioassay samples, and tributary samples collected within river/reservoir)																			
Whole	Antimony	mg/Kg	88	131	67%	0.27	19	0.35	63	31	17	16	35	--	--	--	--	NA	--
Whole	Arsenic	mg/Kg	231	246	94%	0.73	4.5	0.65	74	0.39	231	0.12	231	9.8	74	33	4	NA	--
Whole	Cadmium	mg/Kg	216	246	88%	0.047	0.62	0.036	16	37	--	20	--	0.99	131	5.0	28	NA	--
Whole	Chromium	mg/Kg	246	246	100%	--	--	1.2	156	211 ^f	--	200	--	43	43	111	7	NA	--
Whole	Copper	mg/Kg	241	246	98%	6.0	8.7	3.0	3,030	3,129	--	1,490	13	32	140	149	55	NA	--
Whole	Iron	mg/Kg	246	246	100%	--	--	5,140	248,000	23,463	126	--	--	--	--	--	--	NA	--
Whole	Lead	mg/Kg	246	246	100%	--	--	2.6	2,760	400	8	--	--	36	149	128	103	NA	--
Whole	Manganese	mg/Kg	246	246	100%	--	--	92	4,920	1,762	26	1,870	25	--	--	--	--	NA	--
Whole	Mercury	mg/Kg	203	242	84%	0.0070	0.14	0.0040	2.4	23	--	12	--	0.18	90	1.1	17	NA	--
Whole	Nickel	mg/Kg	246	246	100%	--	--	0.68	53	1,564	--	800	--	23	67	49	2	NA	--
Whole	Uranium	mg/Kg	51	246	21%	6.4	84	4.6	127	16	24	8.0	41	--	--	--	--	NA	--
Whole	Zinc	mg/Kg	246	246	100%	--	--	16	26,600	23,463	1	12,000	13	121	158	459	115	NA	--
Whole	Benzo(a)anthracene	µg/Kg	129	246	52%	4.0	17	0.20	32	621	--	240	--	108	--	1,050	--	21.6	128
Whole	Benzo(a)pyrene	µg/Kg	71	246	29%	4.0	18	0.20	16	62	--	24	--	150	--	1,450	--	21.6	71
Whole	Benzo(b)fluoranthene	µg/Kg	68	246	28%	4.0	18	0.20	38	621	--	240	--	--	--	--	--	21.6	68
Whole	Benzo(k)fluoranthene	µg/Kg	68	246	28%	4.0	18	0.20	30	6,215	--	2,400	--	--	--	--	--	21.6	68
Whole	Chrysene	µg/Kg	157	246	64%	4.0	16	0.20	77	62,146	--	24,000	--	166	--	1,290	--	13.79	156
Whole	Dibenzo(a,h)anthracene	µg/Kg	37	246	15%	4.0	18	0.20	4.0	62	--	24	--	33	--	--	--	21.6	36
Whole	Indeno[1,2,3-cd]pyrene	µg/Kg	83	246	34%	4.0	16	0.20	13	621	--	240	--	--	--	--	--	21.6	83
Whole	PCB-1016	µg/Kg	1	243	0%	0.83	4.8	25	25	3,933	--	2,800	--	60	--	676	--	1.54	1
Whole	PCB-1260	µg/Kg	1	243	0%	0.83	4.8	9.4	9.4	222	--	--	--	60	--	676	--	0.533	1
Whole	2,4'-DDE	µg/Kg	4	246	2%	0.67	2.8	0.090	0.48	1,720	--	--	--	3.2	--	31	--	1.72	4
Whole	2,4'-DDT	µg/Kg	13	246	5%	0.67	2.8	0.090	6.5	1,720	--	--	--	4.2	1	63	--	2.04	13
Whole	4,4'-DDD	µg/Kg	2	246	1%	0.67	2.8	0.35	2.1	2,437	--	729	--	4.9	--	28	--	2.85	2
Whole	4,4'-DDE	µg/Kg	26	246	11%	0.67	2.8	0.072	5.2	1,720	--	515	--	3.2	1	31	--	1.72	26
Whole	4,4'-DDT	µg/Kg	54	246	22%	0.67	2.8	0.080	20	1,720	--	515	--	4.2	4	63	--	2.04	54
Whole	Aldrin	µg/Kg	1	246	0%	0.33	1.4	0.17	0.17	29	--	10	--	--	--	--	--	0.040	

TABLE 4-1

Summary of Analytical Results and Comparison to Screening Levels

Upper Columbia River RI/FS

Size Fraction	Analyte	Units	Summary Statistics								Comparisons to Screening Levels									
			Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetect Value	Maximum Nondetect Value	Minimum Detected Value	Maximum Detected Value	PRG Soil Residential ^a	Number of Detects > PRG	STI HSCA HH ^b	Number of Detects > STI HSCA HH	TEC ^c	Number of Detects > TEC	PEC ^d	Number of Detects > PEC	CCT HH Value ^e	Number of Carbon-Normalized Detects > CCT HH Value	
Reference Samples																				
Whole	Arsenic	mg/Kg	3	6	50%	1.4	1.9	3.1	3.4	0.39	3	0.12	3	9.8	--	33	--	NA	--	
Whole	Cadmium	mg/Kg	6	6	100%	--	--	0.16	1.3	37	--	20	--	0.99	1	5.0	--	NA	--	
Whole	Nickel	mg/Kg	6	6	100%	--	--	4.9	24	1,564	--	800	--	23	1	49	--	NA	--	
Whole	Benzo(a)anthracene	µg/Kg	3	6	50%	7.0	9.0	0.30	1.0	621	--	240	--	108	--	1,050	--	21.6	2	
Whole	Chrysene	µg/Kg	2	6	33%	7.0	9.0	1.0	2.0	62,146	--	24,000	--	166	--	1,290	--	13.79	2	

^a USEPA Region 9 Preliminary Remediation Goal (USEPA, 2004a).^bSLOC Resolution 2004-85, Appendix B. It should be noted that application of these values to assessment of risk is limited where multiple contaminants are present, multiple media are contaminated, or multiple pathways are impacted. In addition, application of the values requires consideration of background concentrations and sediment particle fractionated data.^c Threshold effects concentration (MacDonald et al., 2000), adopted by Colville Confederated Tribes and Spokane Tribe.^d Probable effects concentration (MacDonald et al., 2000).^e Confederated Tribes of the Colville Indian Reservation (CTLOC Chapter 4-16, Appendix C).^f PRG value presented is for total chromium, based on assumption of 1:6 ratio of chromium (VI):chromium (III). Phase I sediment samples were not analyzed for chromium species; therefore, Phase I sediment results are compared only to the PRG value for total chromium.

HH = human health

CCT = Confederated Tribes of the Colville Indian Reservation

mg/kg = milligrams per kilogram (parts per million)

NA = not applicable

ND = nondetect

pg/g = picograms per gram (parts per trillion)

PEC = Probable Effects Concentration

TEC = Threshold Effects Concentration

STI = Spokane Tribe of Indians

µg/kg = micrograms per kilogram (parts per billion)

um = micrometer